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ABSTRACT

This paper describes an innovative technology infrastructure for teacher preparation in a land grant university that is committed to a vision of technology-using educators--the new Undergraduate Teacher Development Center (UTDC) at the University of Missouri College of Education, designed through a collaborative process with school districts and members of the government and business communities. Described in detail, key pieces of the technology infrastructure for the UTDC include: (1) a set of technology markers (i.e., milestones or achievements expected of students) for teacher education majors; (2) provision of laptop computers for teacher education students and faculty, in order to achieve the high expectations for student outcomes as represented by the markers; (3) support for using technology; (4) the Interactive Shared Journal System, an Internet-based tool for enabling students to create journals about field experiences and share these journals with other educators; and (5) a partnership with 19 school districts, including a telecommunications system to connects with these schools. Three short case reports are used to describe how the technology infrastructure is influencing teaching and learning in the College of Education. Lessons learned in the first year are discussed in terms of technical challenges, access/usage, and curriculum integration. (AEF)

A Technology Infrastructure for Teacher Education

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Today's colleges of education and systems of teacher development do not adequately prepare teachers to use technol ogy in their teaching or in their own professional development. The Office of Technology Assessment (OTA, 1995) reported on technology in teacher education and noted significant limitations: 1) faculty do not model the technology, 2) students learn about technology, not with it, 3) field experiences are not designed to model the use of technology, and 4) technology is isolated from the main curriculum and pedagogy of teacher education. The OTA report identified some promising new approaches being used in a few teacher education programs, but new models of preparing teachers for learning and teaching in an age of technology need to be developed.

The need for improved teacher preservice development programs is heightened by the realization that half of the teachers who will be teaching in 2005 will be hired over the next decade and this large scale hiring will continue over the following decade (Gerald & Husser, 1991). In a briefing paper for the National Commission on teaching & America's Future, Linda Darling Hammond (1996) illustrates how this is a critical historical moment for transferring the capacity of the American teaching force by transforming the quality of their preparation.

This paper describes an innovative technology infrastructure for teacher preparation in a land grant university that is committed to a vision of a technology using educator, and has made a substantial investment n reform and infrastructure.

Background

In 1993 the University of Missouri (MU) College of Education (COE) made a commitment to a vision of a teacher as a reflective and inquiring professional. The new undergraduate teacher development center (UTDC) was designed through a collaborative process with school districts and members of the government and business communities. The COE has restructured the teacher preparation program to focus on field-based inquiry and reflective practice as two key methods for teacher development. Freshmen in the 1996-97 academic year were the first cohort to undertake this new UTDC program. This commitment to an improved COE undergraduate program is taking place in the context of a university-wide commitment to improved undergraduate education. For example the MU undergraduate general education program received the 1997 Theodore M. Hesburgh Award from the American Council of Education, and NSF has recognized MU along with nine other universities as a research-intensive university that has made a substantial commitment to integrate research and education for undergraduates.

The new UTDC is also based on a second commitment to produce a new generation of educators who can help achieve higher levels of learning utilizing modern information technology. A key aspect of the new program is the inclusion across all phases and components of the UTDC of outcomes for the ability to use technology. Perhaps even more significant is the investment of $3.4 million by the University to build a learning community enabled by a technology infrastructure, to develop new teachers who become users, advocates, and life-long learners of technology.

Described below, the technology infrastructure for the UTDC includes: 1) developing a set of technology competencies for teacher education majors, 2) having each student possess a laptop computer to insure high levels of access to technology, 3) providing faculty with advanced technology, 4) connectivity between the COE and partner school districts, 5) using electronic tools to capture, share and reflect upon experiences, and 6) creating new forms of support for using technology. The COE envisions a community of educators enabled by advancing technology for shared and continuous professional development. For example, the Interactive Shared Journal System that allows preservice teachers to capture and share their experiences can also be used by inservice teachers to reduce the isolation of teaching and bring the resources of the education/learning community to bear on the problems of practice.

Key pieces of the technology infrastructure

A set of technology markers

Markers refer to milestones or achievements expected of the student. They refer to objectives for the technology

competencies and knowledge of the undergraduate teacher education student. These markers are expected to evolve and grow as the faculty gain experience in supporting students to achieve them and as the technology infrastructure grows and improves. The markers are intended to provide a solid beginning for a lifetime of technology use and continued professional development. They emphasize that technology is a means to valued, shared goals of the program: communication, diversity, and inquiry. All phases and components of the UTDC have technology markers that are expected to contribute to the following principle and goals:

Effective teachers use technology to participate in a community for professional development, to engage in personally meaningful inquiry, and to support teaching, learning, and assessment with their students.

1. Use technology to communicate with others, share information, reflect, and engage in professional development.
2. Integrate technology in managing and facilitating instruction, assessment, and learning.
3. Use technology for inquiry in content areas across the curriculum.
4. Explore existing and emerging technologies to determine their potential usefulness.
5. Expand students' experience and understanding of multiple perspectives through use of technology.
6. Examine the educational, ethical, political, and cultural implications of technology

Personal computers for teacher education students.

Apple Powerbook 1400's were provided to all 270 freshmen in the class of 2000 and to all 30 faculty implementing the first phase of the UTDC. A similar number of freshmen and faculty have received powerbooks for the class of 2001. The UTDC program has been designed with the expectation that students will have technology competencies and technology capabilities. In order to achieve the high expectations for student outcomes as represented by the markers, it became apparent that individual students each need a mobile and powerful system. To this end each member of future freshman classes will receive a personal laptop computer. The plan is to replace the student computers after 2.5 years with the most current and appropriate version available.

Support for using technology

The Reflector is the COE laboratory and support system for applying learning and technology innovations. The Reflector is a learning and performance support center that integrates interactive networked technology with traditional media resources. In most colleges, the Reflector would be called the media center, but the Reflector has been designed around the goal of developing a reflective professional educator. An essential role of the Reflector is to connect practicing educators with preservice teachers, in virtual and actual settings, thereby enabling today's and tomorrow's educators to exchange experiences, challenge assumptions and test ideas. The Reflector also includes a team of Learning and Performance Support (LAPS) specialists who provide learning and support on an as needed basis, with the belief in right-time, right-place, right-form support.

Interactive Shared Journal System (ISJS).

The ISJS is an Internet-based tool developed in the COE for enabling students to create journals about field experiences and share these journals with other educators in their community of professional development. ISJS integrates a set of Internet-based tools, such as web browsing, e-mail, and chat, with the shared journal tools to create an advanced system for supporting learning from field-based experience. The ISJS will be a core technology for supporting the teaching and learning experiences of the UTDC and will be integrated into most courses as well as for connecting preservice teachers with the experiences of inservice teachers. (Laffey & Musser, 1997 & 1996).

Connections with Schools.

The COE has formed a partnership with 19 school districts around the state of Missouri, who form a web of emerging professional development schools. The COE has invested in building a telecommunication system to connect with these schools so that preservice teachers and inservice teachers can form a community for professional development. These connections are just getting underway, but several projects represent tests and prototypes for how the community can develop. The test projects include Project MOST (an NSF/NIE award) http://tiger.coe.missouri.edu/~most/index.html and Project Whistlestop (a Department of Education Challenge Grant award to a consortium of several partner schools) http://whistlestop.org .

Implementation of the Technology Infrastructure

Three short case reports will be used to describe how the technology infrastructure is influencing teaching and learning in the college of education. In preparation for these case reports consider two extremes of design. On one end of the spectrum, goals and objectives are set, designers specify pathways from a current status to a desired end, evaluation measures are put into place, and a master plan is executed to systematically eliminate or minimize the prospect of error. This traditional design type works well in steady state environments, where there is a core of experience, and outcomes are predictable. On the other end of the spectrum is an approach called rapid prototyping, where mistakes are expected and lessons are rapidly learned and turned into system improvements. Rapid prototyping is used in organizations when speed to market is essential and when

key parts of the system are novel and the impact is unpredictable. Our approach to implementing a technology infrastructure required both types of design processes. When you are handing out three hundred laptops to freshmen you need to think through a process of installation, testing, and start-up that is efficient and minimizes confusion. You cannot anticipate every problem that will arise, but based on experience you can plan for a certain number of systems that will fail, a number of students who will need extra help, and a need for custom settings and configurations to minimize the level of expertise needed by students to get started. However, you cannot anticipate the degree to which faculty will appropriate technology into their curriculum or what type of support they will need as they start to envision listservs, web pages, mediated presentations, and uses of custom software. You need flexibility to adapt and adjust as opportunities or challenges arise.

Support, Support, and more Support

In less than a four year time span the college of education has moved from classroom and lab access of about 40 computers and less than 100 computers in faculty and staff offices, to approximately 1800 computers in various capacities of use in the college. To support this rapid growth in computer access and use the LAPS team was created and has grown to 6 staff members. In a given month the team logs approximately 300 e-mail and phone work orders. In addition to fixing computers, installing software, and troubleshooting network problems, the LAPS team provides training and specification for new equipment. A system administrator provides a network of listservs, e-mail addresses, webpage maintenance, an other sharing services.

An instructional materials center that historically provided access to materials required by instructors has been transformed into the Reflector. The Reflector is open 7 days a week and provides access to computers in a context of multi-media tools, printers, network and Internet services, and high levels of support from a customer-oriented staff. A typical month in the Reflector has over 20,000 users. The physical space of the Reflector has been designed not as a place of computing, but rather as a place of work and learning that is supported by computing. There are multiple types of spaces facilitating collaboration, production of artifacts, and use of multiple resources including books, computers, and people.

Internet-based Shared Journals

The teacher-education faculty designed a new curriculum emphasizing learning from field-based experience with the goal of developing reflective practitioners. Student use of journals to share their experiences and thoughts has been a commonly used tool for many years among many of the faculty. With a vision of a technology infrastructure providing high access to computing, curriculum goals emphasizing learning from field-based experience, and a shared value among faculty of learning through the use of journals; a software development team created a client-server environment for students and faculty to report, share, and reflect through an interactive, internet-based, shared journal system. The most common journal assignment in the first year has been a faculty assigned task, such as visiting a school site and observing a student or classroom and then reporting on the observation. Faculty then read the journals on-line and have the capability of writing appends (an attached journal entry) to the student entry. Some faculty have encouraged students to share journals by asking them to read and append to fellow student journals.

The use of the journal system has been one of the most challenging features of the new technology infrastructure. On the one hand many faculty and students have appropriated the tool to enhance the way they communicate and make sense of their experiences. Some faculty are developing innovative designs for curricular use, such as creating a journal environment for virtual students, wherein the teacher education students would build a virtual school and describe experiences through the eyes of virtual k-12 students. Similarly, in focus group sessions, students have discussed how the journal, since it is a tool they will use throughout the teacher education program, will help them to look back over their experiences facilitate a better understanding of new experiences. Students have also discussed reviewing entries made by other students to help understand observations they are making in classrooms. On the other hand, however, some faculty are reluctant to use the journal system. There are several reasons for this reluctance, including other preferred ways of working, limited experience with technology, technical problems of the network and journal software which have made it unreliable at times, and just being overwhelmed with all the other programmatic changes.

Mobile Laptop Program

Putting computer technology in the hands of all students and faculty is a technical, social, cultural, business and political process. Our process included testing several potential platforms for supportability and functionality, testing all of the possible system peripherals, developing the program-specific software configuration that replaces the initial Apple configuration, developing mass production systems in order to update each system, and providing training sessions for laptop use. In addition, the process included orchestrating the related business endeavors to purchase, finance and secure the systems. The selected systems include:

Hardware:

- Macintosh Powerbook 1400cs
- 16 Mb RAM expandable to 64Mb, 750Mb Hard Drive
- Internal 6x CD-ROM and floppy disk drive
- 800 x 600 Color Display
- 33.6 Modem/Ethernet PC Card

- 133 Mhz with level two cache high performing chip
- Built-in infrared technology
- Customizable Book Cover
- Shoulder or Backpack Carrying Case

Software:

- Claris Works (integrated word processor, drawing program, database, communications program, and spreadsheet)
- Claris Organizer (schedules and contacts tracking)
- Apple Internet Connection Kit (Netscape Navigator, Claris E-mailer Lite, Fetch, NCSA Telnet and NewsWatcher)
- MU Internet Suite (a supplement for the Apple Internet Connection Kit)
- Apple Remote Access (For connection to a desktop or network from a remote location)
- Macintosh Easy Open and DataViz Easy Open (translator for reading and writing PC-formatted floppy disks and PC-formatted files)
- Interactive Shared Journaling System (multimedia journaling application supporting communication among students and faculty in local and remote locations)
- Eudora Pro (user friendly E-mail application)

Early lessons

Many of the lessons learned in the first year can be placed into three categories: technical, access/usage, and curriculum integration.

Technical. Meeting technical challenges provides a foundation for usage and curriculum integration. To a great extent most of the technical components of laptops, software, servers, and networks are well understood, and one could model a technical plan after those used by other organizations. Two of the key drivers for the technical plan were ease of use and mobility. Since many of the students and faculty were essentially novice users of technology, and much of the value of the technology infrastructure was driven by network access, it was important to make networking simple. However, since the students and their laptops were mobile networking was complex; access needed to be supported from within the college of education, in the dorm rooms or in a k-12 school. A custom configuration of network tools and settings were installed on each laptop. Similarly, custom tables were created to make it easy for students during class or in the Reflector to connect to the campus network. This system, however, proved too fragile and students frequently were confronted with error message or unexpected outcomes of trying to make network connections. Problems included: inadequate dynamic allocation of IP addresses, user confusion about when to use the modem or the ethernet adapter, faulty cables, unreliable software, inadequate training of students for what to do when an error occurred, and difficulty in updating software on the laptops when a problem was diagnosed and corrected. Planning the technical installation and resolving problems consumed great amounts of energy and mind share during the first year, but one can look at the technical features of the system and see that technical hurdles are becoming manageable. The combination of technical solutions and a more experienced community of users is progressing toward a sound and effective technical implementation.

Access/usage.

A somewhat naive conception is that access to the technology will inevitably lead to appropriation of the technology. In many ways this simple notion is being borne out. But, a more powerful notion of access sees it framed in a set of conditions, such as to what end and enabled by what support. Access to an appropriate form of support may be nearly as critical as access to the technology. While some forms of group training are required by the need for efficiency, most of our efforts to develop competency are moving away from training models and toward support models. To the extent possible we are designating a technology support person for most groupings, encouraging buddy systems, extending hours of the reflector, creating self-paced explanations and skill building, and leveraging competencies developed by one set of students to facilitate the next set of students. These types of activities need to be planned and coordinated, but in a certain sense they are also organic. As our community becomes more densely populated with competent technology users the process of inducting a next cohort should become easier, just as learning a foreign language is easier if you are among people who speak that language naturally and frequently.

Curriculum Integration. Curriculum integration means both the use of technology as a key component of the curriculum and of changing the curriculum because of what technology enables. Clear progress is being made by many faculty on the use of technology in their curriculum. Like many other newly introduced technologies the technology infrastructure and the journal system in particular are at first being used to replicate existing patterns of work, primarily communication between the teacher and student. As faculty become more experienced with the tools, they start to see other benefits and possibilities, such as the virtual school and collaboration among students mentioned earlier. One initiative underway is to use the journal system to connect preservice science teachers with high school students involved in project based learning. The high school students use the journal system to report on their project work, and the preservice teachers use the journal to "observe" project based learning. One of our science education faculty has developed a methods curriculum that has the science education students use the journal to facilitate moving through various roles of observer, mentor, and teaching assistant for the projects underway in the high schools. The

asynchronous nature of journaling and the Internet wide basis of the journal facilitates connecting preservice teachers to innovative k-12 experiences wherever they may occur across the state.

Conclusion

There is no silver bullet for bringing the benefits of advancing technology to bear on improving teaching and learning. However, a technology infrastructure that enables preservice teachers to learn in a context of computing and network services seems fundamental to developing attitudes, values and competencies for making technology a tool of teaching. The technology infrastructure cannot simply provide lessons about using technology in curriculum, it must enable teachers to learn to use technology for continuous professional growth and development. The technology infrastructure of the College of Education at the University of Missouri, while no doubt still under construction, is a substantial step towards understanding how to build and support a technology infrastructure and towards providing beginning teachers with powerful new conceptions and tools for using technology as a part of their learning and teaching.

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